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The American STATISTICIAN

DECEMBER 1948, Vol. II, No. 6

The news publication of the American Statistical Association

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PEACETIME IMPLICATIONS OF OPERATIONS RESEARCH

During World War II, a new field of scientific activity developed in England and the United States, known generally as *operations research* or *operations analysis*. Teams of scientists drawn from such varied fields as biology, chemistry, economics, engineering, mathematics, physics, psychology, and statistics, were attached to military commands in the various theatres of operations. Their job was to bring their scientific training jointly to bear on the operational problems of warfare — to evaluate the combined performance of men, materiel, and tactics under combat conditions and to recommend improvements. In the words of Admiral E. J. King, there were two main aspects to this work: "theoretical analysis of tactics, strategy, and equipment of war on the one hand; and statistical analysis of operations on the other."

The work of these operations research teams was extraordinarily fruitful in bringing major needed improvements in equipment, training of men, and combat tactics. The Air Force and Navy, and more recently the Army, use operations research methods and personnel extensively in connection with their peacetime operations.

Since the War, there has been considerable discussion both in England and here of the possibility of applying these methods on a large scale to the problems of business, industry, and government. Two extreme views on this subject have developed. A number of the scientists who participated in the wartime operations research activity feel that this is a brand-new technique with great possibilities for useful application to peacetime problems of business, government, and industry. On the other hand, men more closely associated with business and industrial management usually feel that operations research is merely a new bottle for old wine. They feel that operations research scientists who claim this activity to be something new do not understand the extent to which large business, industrial, and governmental operations are actually studied, evaluated, and then improved accordingly.

Our position is intermediate between these two extremes. The wartime operations researcher is often not in a position to know the extent to which rather highly developed techniques are already being applied in all phases of the industrial process, including research and development, production, distribution, and marketing. Leaders in business and industry, on the other hand, are often unfamiliar with recently developed scientific techniques that could be readily adapted to their management problems. What *is* new, and important, is the recognition of the value of an integrated team approach, combining the insights and techniques of the electrical engineer and the psychologist, the statistician and the philosopher, the economist and the chemist, the physicist and the physiologist, or whatever the appropriate combination may be for the particular problem at hand. A real

CONTINUED ON PAGE 17

NEWS

The election polls — ASA annual meeting program changes — a statistical handbook — training conference on industrial experimentation — local statistics committee appointed — new publications

Changes in the Program of the Annual Meeting in Cleveland

New sessions added:

Dec. 29—9 A.M.-Noon

"Statistical Problems in the Kinsey Report", W. Allen Wallis, University of Chicago; "Why the Election Polls were Wrong", Philip M. Hauser, University of Chicago, and Morris H. Hansen, Bureau of the Census.

Dec. 28—4-6 P.M.

"Progress and Problems in Communicating Facts and Ideas", Rudolph Modley, Executive Research, Inc.

"Visual Aids in Presenting Statistical Data and Methods", Herbert Arkin, The City College of New York.

"The Graphic Presentation of Data for Industrial Purposes", John V. Sturtevant, Carnegie-Illinois Steel Corporation.

"Labor Force 'Disappearance' During Depressions", Harold Wool, U. S. Bureau of Labor Statistics.

Cancellations:

Dec. 28—10 A.M.-Noon

"Review of Statistical Methodology", W. Allen Wallis, University of Chicago.

Dec. 28—4-6 P.M.

"Critical Appraisal of the Bureau of Agricultural Economics", Raymond Jessen, Iowa State College; "The Logic of Scales", Louis Guttman, Cornell University.

Studies in social psychology in World War II

Princeton University Press has announced that it will publish the record of over a half million men interviewed by the army during the war. The first two volumes to be published in the spring will be called "The American Soldier". Volume I, will deal generally with problems of personal adjustment during army life and Volume II will deal more specifically with psychological problems of combat and its aftermath. The Editorial Committee for the Volumes includes Samuel A. Stouffer, technical director of the research enterprise, Carl I. Hovland, Leonard S. Cottrell, Jr. Chapters have been contributed by Edward A. Suchman, Louis Guttman, Robin M. Williams, Shirley A. Star, John A. Clausen, M. Brewster Smith, Irving L. Janis, Arthur A. Lumsdaine, Marion H. Lumsdaine, Frederick D. Sheffield, and Paul F. Lazarsfeld.

ASA members invited to Marketing luncheon in Cleveland

Dr. George Gallup will speak on "Opinion Polls" at the Wednesday luncheon meeting, 12:30 P.M., December 29, of the American Marketing Association. All members of the American Statistical Association are invited to attend the luncheon at the Hotel Allerton. Tickets will be available at $3.00.

German Statistical Association Meets

Between September 22 and 27, the German Statistical Association met in bomb-battered Munich to celebrate the 200th anniversary of the teaching of statistics in German universities. This convention marks the resumption of German professional statistical activity after a wartime and postwar period of hibernation.

The meetings were primarily concerned with the reorganization of statistical work in Germany under the difficult conditions currently prevailing. Dr. Klaus Szameitat spoke on "New Methods of Census Taking". The other paper, by Dr. Charlotte Lorenz, covered the "Past and Present of Higher Education in Statistics in Germany". Dr. Lorenz pointed out that in 1748 Gottfried Achenwall delivered lectures in Goettingen on *Notitia politica vulgo statistica* and that as early as the 16th Century European scholars prepared compendia of statistics on the most important countries of the world.

The new chairman of the German Statistical Association is Dr. Wagner, Chief of the Bavarian Statistical Office.

A statistical handbook

The American Statistical Association is considering the possibility of sponsoring or preparing a "Statistician's Handbook." An ad hoc ASA Handbook Outline Committee has been appointed, with Professor John W. Tukey of Princeton University as Chairman, to study this possibility and make recommendations to the Board of Directors concerning the proper organization and content of such a book. There are some forty members of the Association working with Professor Tukey on the Committee to ensure representation of every major field of statistics and its applications. The Committee expects to have its report ready before the time of the annual meeting in Cleveland.

WHAT OF THE OPINION POLLS?

The spectacular results of the 1948 election highlight the problems of the pollers. Statistically, these problems are common to all who use the so-called quota method of sampling. The solutions have been well-known for many years, and the hope is that prompt steps will be taken to remedy the statistical defects.

Correct sampling requires that every member of the population shall have a known chance of being drawn into the sample. If the regions to be sampled are selected by the sampler in non-random fashion and if the respondents are similarly selected by the interviewer then all probabilities are unknown. Result: Ever present sampling variation is entangled with unknown quantities of bias due to faulty design and there is no way to disentangle them.

If the sampling were random, sampling variation could be evaluated and changes in population between the times of the poll and of the election could be measured and tested. These matters are discussed by me in greater detail in an article in this issue, written in September for presentation before the Chicago and the Central Indiana Chapters of the Association.

It should be clear that there is no reported distinction between the samplings for the elections and others from time to time made by the pollers. Any of these samples may be in error by an amount which cannot be determined. Technically, it is merely an incident that one of the populations is enumerated on election day. Aside from opportunities of study and improvement, statisticians should perhaps be less concerned about the few samples subject to verification than about the many which go unchallenged.

Aside from statistics proper, there are two problems of reporting the polls that can easily be solved. One is the confusion of the results of the sampling with the opinions of the samplers. The reader is interested in both but he would like them served in separate dishes. Not only the polling organizations but statisticians in general would benefit from clear distinctions among sample facts, estimates of population figures, and predictions based upon the two.

The second problem of reporting is one emphasized in the Congressional investigation of the polling of the election of 1944 (Hearings on H. Res. 551, Part 12, December 28, 1944). In the final releases, the undecided respondents are often allocated to the leading candidates in some manner not explained. Other pertinent information is sometimes hinted but not reported. This deprives the reader of the opportunity to judge the predictions of the poller and to make his own. Again it would seem that the polling organizations would themselves have most to gain by remedying this situation.

The most difficult problems are those in the social field—psychology, sociology, economics. The selection and training of competent interviewers, the structure of the questionnaire, the techniques of the interviewer-respondent contact, the ability and willingness of the respondent to answer the questions asked; these are some of the troublesome concerns of those responsible for surveys. For this reason it is a happy circumstance that the American Statistical Association has joined the Social Science Research Council in a study of the problems of the polling organizations. Some of the most prominent of these have readily agreed to make their data available to a joint committee consisting of Dr. Samuel S. Wilks, director of the Section of Mathematical Statistics, Princeton University, and editor of The Annals of Mathematical Statistics, chairman: Dr. James Phinney Baxter 3d, president of Williams College; Dr. Carl Hovland, chairman of the Department of Psychology, Yale University; Dr. Isador Lubin, chairman of the Committee on Statistical Standards of the American Statistical Association; Dr. Frank Stanton, President of the Columbia Broadcasting System; Frederick F. Stephan, professor of social statistics and director of the Study of Education, Princeton University, and Dr. Samuel A. Stouffer, professor of sociology, Harvard University, and director of the Laboratory of Social Relations. I have great expectations of this cooperation among the professional societies and the sponsors of the polls.

GEORGE W. SNEDECOR,
President, American Statistical Association

Unified Reporting System for the Social Sciences Studied

The Social Science Division and the Graduate Library School, University of Chicago, aided by a grant from the Carnegie Corporation, are jointly undertaking a study of the desirability and feasibility of setting up a unified reporting system for the social sciences. Opinions of social scientists, teachers, students, librarians, public officials, interest-group leaders, and other potential users are being collected with regard to the relative advantages of a yearbook; a journal containing abstracts; a journal consisting largely of bibliographic essays; and other means of publication.

The study is being conducted by Bruce Lannes Smith, political scientist, aided by the following advisory committee: Bernard Berelson, Dean, Graduate Library School; Fred Eggan, Associate Professor, Anthropology; Herbert Goldhamer, Associate Professor, Sociology; Louis Gottschalk, Professor, Modern History; Nathan Leites, Political Scientist; Ralph W. Tyler, Dean, Social Sciences Division; W. Allen Wallis, Professor of Statistics and Business Economics.

David M. Schneider represents ASA at inauguration of new president of Clarkson College

The American Statistical Association was represented by Dr. David M. Schneider of Albany at the inauguration of President Jess H. Davis of Clarkson College on October 8.

Dr. Schneider is a former vice-president of the A.S.A. Over 100 colleges and universities and 25 learned and professional societies sent delegates to the inaugural ceremonies.

World Health Organization issues new manual

The new Manual of International Classification of Diseases, Injuries, and Causes of Death will be issued by the World Health Organization at the end of 1948. The new classification will go into effect on January 1, 1949. The price of the first printing is $2.50, a set of two bound volumes delivered. Orders and checks for the publication should be sent to Halbert L. Dunn, Secretary-Treasurer, Council on Vital Records and Vital Statistics, c/o National Office of Vital Statistics, Washington 25, D. C.

Training Conference on Industrial Experimentation

The role of mathematical statistics in the design, analysis, and interpretation of industrial experiments was the major theme of a five-day intensive Training Conference on Industrial Experimentation held at Columbia University from September 14th to 18th. The conference, which was sponsored by the Department of Industrial Engineering of Columbia University in cooperation with the University's Department of Mathematical Statistics, was attended by thirty-seven selected conferees representing a dozen different industries located in the United States and Canada.

The conference staff, composed of three members of the faculty of Columbia University and five specialists drawn from representative industries, consisted of the following: *Full Time:* Prof. S. B. Littauer and Mr. R. E. Bechhofer, Department of Industrial Engineering, and Professor J. Wolfowitz, Department of Mathematical Statistics; *Special Lecturers:* Dr. B. L. Clarke, Director of Controls, Merck and Company, Inc.; Dr. E. V. Lewis, Carothers Research Laboratories, E. I. duPont deNemours; Dr. Harry G. Romig, Bell Telephone Laboratories, Inc., L. E. Simon, Director, Ballistic Research Laboratory, Aberdeen Proving Ground; and Mr. Ralph E. Wareham, Vice President, National Photocolor Corporation and President, American Society for Quality Control.

The program of activity was divided into two parts: a three-hour morning session during which the three full-time staff members presented fundamental statistical theory, and a three-hour afternoon session during which the five industry specialists (one on each day) discussed problems in experimentation peculiar to their own industries. Following the industry speaker, the entire staff led a group discussion of the material covered in the morning and afternoon sessions. Conferees raised questions concerning the application of the material discussed to their own problems in experimentation. Further discussion and exchange of ideas were carried on during group luncheons and dinners held at the Men's Faculty Club.

During the morning sessions some of the statistical techniques commonly employed in industrial experimentation were subjected to critical analysis in the light of current statistical theory. Emphasis was laid on the importance of specifying precisely the mathematical statistical model before attempting tests of significance and problems of estimation. Attention was centered on the Analysis of Variance and the theoretical structure and practical interpretation of Models I and II, as applied to randomized blocks, two-way classifications, and Latin squares, were thoroughly explored. The estimation of variance components was described. The meaning of a test of significance and the power of the test were discussed at length. All theoretical models were motivated by practical problems. Numerical examples were provided.

Many of the questions raised by the conferees were of considerable theoretical as well as practical interest. Some of these, such as the method of conducting exact tests of significance when observations are missing, could be answered easily using current statistical theory (although the compuations involved in applying the theory might be laborious); others, such as the effect on the significance level and on the power of the test when repeated tests of significance are applied to the same set of data, revealed the undeveloped area of current theory since qualitative rather than exact quantitative answers had to be given. Both of the above questions, which were real sources of concern to the industrial experimenters, pointed up the dilemma faced by the practical man who must deal with problems for which the theory is unknown to him or is undeveloped. Perhaps one of the most important by-products of the Conference was a highlighting of some of the pertinent theoretical statistical problems which must be solved to supply the requirements of the industrial experimenter.

Applied Statistics Conference held at Auburn, Alabama

A conference on statistics applied to research in the social sciences, plant sciences, and animal sciences, was held at Auburn, Alabama, September 7-9. Ninety-two applied scientists and statisticians, representing 14 states and Washington, D. C., attended the conference.

The Conference was sponsored by Alabama Polytechnic Institute in cooperation with Iowa State College, University of North Carolina, Virginia Polytechnic Institute, United States Department of Agriculture, and Southeastern Agricultural Experiment Stations. Financial assistance in the form of a grant-in-aid was received from the General Education Board.

Lectures were given on techniques and designs involved in the application of statistical techniques to research problems in the above mentioned sciences. The lectures were followed by brief research reports illustrating the use of the statistical techniques in actual experimental situations. One session was allocated to a discussion of the organization and promotion of statistical activities at colleges and universities with special reference to regional operation in the Southeast.

The lectures in full accompanied by abstracts of the brief research reports will be made available in the near future by the Statistical Laboratory, Alabama Polytechnique Institute, Auburn, Alabama.

Statistical supplement to "Survey of Current Business" now available

The Office of Business Economics, Department of Commerce, has completed the 1947 Statistical Supplement to the "Survey of Current Business" which is now available at the Government Printing Office. This is the first historical supplement published since the war, and it provides monthly data for the period from January 1941 through December 1946 giving monthly averages for the years 1935 to 1946, inclusive.

Of the more than 2,500 series of data included

in this volume, many are new, others are new classifications of old series, and many of the old series have been extensively revised. Every effort has been made to relate the new series to and fit them in with previous statistics to provide data comparable throughout the entire period covered and bridging the gap between prewar and postwar data.

The descriptive notes giving sources of data, telling where similar data and those for prior periods can be found, giving basic information describing the nature of data as it applies to business and economic problems, are an especially useful feature of the volume.

Census Library Project releases annotated bibliographies

"National Censuses and Vital Statistics in Europe, 1939-47—A Supplement", fourth in a series of annotated census bibliographies, has been released by the Census Library Project. Reference material published in an earlier issue, "National Censuses and Vital Statistics in Europe, 1918-39", is continued through 1947 and also lists and describes all official censuses as well as serial and other official publications containing demographic and vital statistics issued by the governments of the several European countries.

In addition to the European bibliography, the Census Library Project has compiled and published the following annotated bibliographies: "General Censuses and Vital Statistics in the Americas", 1943; and "State Censuses, 1790-1948", 1948. A "Catalog of United States Census Publications, 1790-1945" is now in preparation.

The Census Library Project was initiated in 1940 as a cooperative project of the Bureau of the Census and the Library of Congress in accordance with a resolution passed at the Eighth American Scientific Congress. The original scope of the Project contemplated the collection of census and vital statistics materials of the world and making these data available for research and operational use. These general objectives have been redefined somewhat by the demands for service in this field. At present the continuing functions of the Project are: (1) to cooperate in the completion of the Library of Congress collections in the fields of census and vital statistics for all areas of the world; (2) to achieve world coverage through census bibliographies in order to facilitate the use of the collections of such documents in the principal libraries of the United States; and (3) to act as a reference service for government agencies and the general public.

Census Advisory Committee established

An Advisory Committee on State and Local Government Statistics to advise on plans and policies for Census reporting of governmental statistics has been established by the Governments Division of the Bureau of the Census. The Committee is concerned chiefly with the Bureau's "Current Government Statistics" program, but it will also act in an advisory capacity to the decennial Census of Governments now expected for 1952.

American Society for Quality Control, Washington Section

Dr. Jack Youden spoke on "A study of Triplicate Determination in Analytical Chemistry at the October meeting of the Washington Section of the ASQC. Washingtonians interested in industrial quality control are invited to get in touch with Ed. R. Salzer, Secretary-Treasurer, Washington Section ASQC, 8621 Georgia Avenue, Silver Spring, Maryland.

Sources of Farm Statistics listed

A complete list of the economic and statistical publications of the Bureau of Agricultural Economics of the U. S. Department of Agriculture is given in a new publication of the Bureau, "Agricultural Economic and Statistical Publications". The sources are described and the contents summarized. Besides listing all the periodicals and scheduled reports of the BAE, it lists all the economic and statistical publications the Bureau now has available. The Bureau's organization is outlined and names and addresses of heads of division and field offices are given. Copies may be requested from the Division of Economic Information, BAE, USDA, Washington 25, D. C.

British Register of Research in the Social Sciences

The National Institute of Economic and Social Research in London has been preparing a register of research in the social sciences for private circulation. It has the cooperation of all of the British universities and independent research centers which provide the information to make this unusual reference book possible. It lists a large number of research items, of which over half are documented by descriptions of the scope of the projects; the names of research workers; data on publication of results, and probable dates of completion.

The Register is to be published annually, and will cover the organized work which has as its fundamental aim the improvement and development of the social sciences. In general, it excludes the work of private persons, commercial and political bodies, and by government departments directly.

The work is grouped under broad headings and arranged alphabeticaly within subject groups under the name of the sponsoring body. There are 13 main groupings, and since statistical methods are employed in most of the work referred to, entries of interest to the statistician are found throughout. The sections and sub-sections of demography, economics, education, psychology, social medicine, and social surveys have the greatest statistical interest.

The Register contains a directory of institutions, and is indexed both by subject and by research worker's names. It will be published annually in the early summer. Its present price (for the current issue, No. 5), is $3.25. It can be obtained on a subscription basis from the Chicago University Press, 5750 Ellis Avenue, Chicago 37, Illinois, acting as agent for the Cambridge University Press.

On the Design of Sampling Investigations

by GEORGE W. SNEDECOR
Professor of Statistics, Iowa State College

Professor Snedecor's discussion of the design of sampling investigations was prepared early last fall as a speech which was delivered at meetings of the Chicago and Central Indiana Chapters of the American Statistical Association. No basic revisions have been made since the 1948 presidential elections.

Sampling is one of those things we do every day, almost every hour. We sample our food to learn if it is too hot or if it needs more salt. The doctor tests a single drop of our blood to diagnose our ills. At the blast furnace, the run is sampled for its content of carbon and other chemicals. We read in our papers the reports of samplings of public opinion and of the cost of living. In fact, we get far more information from sampling than from making complete enumerations.

This wide-spread use of sampling means that people have built up a body of common sense about the way to do it. As examples, there are very few who would limit their sampling to a single individual; usually the sample is widely spread and as large as convenient: proportional sampling seems obvious to those who have had their attention called to it. It is clear that since sampling is so common, one must conclude that it is generally successful.

Why, then, should I take up your time for a discussion of the design of sampling investigations? If sampling is merely a matter of common sense, there is no object in further talk. One answer is that common sense isn't very common. Common sense is wisdom about ordinary affairs, and wisdom is always a scarce commodity. More than that, common sense is based on experience of the past, whereas we need to anticipate the future. Let me illustrate. You will doubtless remember the famous Literary Digest fiasco, in which a sample of millions of voters led to a disastrously erroneous conclusion. Here was a bias caused by failure to include in the sample a large and, as it turned out, a determining segment of the population. A far smaller sample properly designed would have produced more reliable results. This is incorporated into our body of common sense since 1936, but then it was not. The theory, however, was available then.

Another illustration: mailed questionnaires are known to be almost always biased, yet they are in general use because of their cheapness. Those agencies which have used this form of sampling for years have learned how to correct for the bias in ordinary times and for the usual run of questions. But when the population is changing rapidly, or when new types of questions are asked, the bias is likely to be notably misleading. During the last war, I was told of one questionnaire mailed to a selected list of farmers, the purpose being to evaluate the need for farm laborers. All the big operators returned the questionnaire listing their shortages. The vast majority of little fellows were too busy doing their own work to bother about replying. The result was a fantastic estimate of 3 or 4 laborers needed on the average farm. Now, the investigating agency wasn't blessed with enough common sense to foresee the disability of such a questionnaire, but fortunately it had enough experience to recognize the returns as absurd, so suppressed the report. I suspect it will not be far in the future that so-called common sense will lead us to distrust the results of most mailed questionnaires. Meanwhile, both knowledge and wisdom are handy.

But scarcity of wisdom is not the only reason for looking carefully at sampling designs. Another reason is the increasing magnitude of the consequences. If you burn your tongue because of inadequate sampling of your cocoa, the suffering is only temporary. So far as I can judge, it is of no consequence at all if you err in your sampling of brands of cigarettes. Small or even large errors in every day samplings may not be very costly. But if you plan to spend $100,000 on a national sample to guide you in a manufacturing and marketing program, anything less than optimum design means hundreds of thousands of dollars wasted on the survey. Even so, that loss may be small compared to the loss due to unsound policy decisions based on the results of the inadequate or inefficient sampling. Another example is the strategic position of the consumers' price index in labor-management relations. Poor sampling design for this index would mean millions to the negotiators. It is this increasing importance of the consequences that raises questions of design above the reach of the common run of experience.

No worthwhile discussion of sampling design is possible without an agreement on the fundamental nature of the process. Sampling consists in examining a portion,

usually a small portion, of some aggregate of individuals, then making inferences about the entire body of individuals. We learn the facts about the sample but we can only infer the desired facts in the population which is sampled. This indicates the importance of designing the sample so that it shall be representative of the population. Otherwise, the sample facts may lead us to incorrect inferences, as was the case in the farm-labor investigation quoted before.

The crucial question, then, is this: "How can a sample be designed so as to be representative of the population?" The answer is in two parts. First, every individual in the population must have a chance of being drawn in the sample; and second, the choice of the individuals in the sample must be random. Unless these requirements are met, there is no way to know whether the sample is representative; that is, there is no way to judge the conclusions about the population. Let us examine these two requirements.

First, every individual in the population must have a chance of appearing in the sample. If the design of the investigation is such that some individuals cannot be drawn, then unknown biases may affect the sample. This was one of the causes of the failure of the Literary Digest prediction of the 1936 election. The mailing lists were taken from telephone directories, lists of registered voters, etc. This was all very well so long as the excluded portion of the population voted like those who were included; but failure resulted when there came a segregation according to level of income. The sample which excluded a substantial segment of the voting population was insensitive to changes affecting differentially the excluded and included portions.

Another way of saying this is that the population represented is limited to those individuals who have a chance of being drawn in the sample. This is frankly admitted in the Hooper ratings. The sampling is altogether by telephone so that the population sampled is confined to those people who happen to be at home and who have both telephones and radios. If there are programs especially popular with non-telephone subscribers, these programs will be under-rated. Another illustration is the ordinary public opinion poll in which all sampling is confined to certain cities and counties selected on a judgment basis. According to my definition, the sample is not representative of any larger population because people in other places have no chance of being included. The population sampled is not the state or the nation at all, but only those regions chosen by the samplers.

The second requirement for representativeness is that the sampling must be random. If the sampler exercises any selection among places or individuals he opens the door to biases due to his selections. This is a problem faced by the samplers of opinion and marketing research organizations. The respondents are selected by the interviewers according to certain criteria which do not include random choice.

If you do not consider this important, let me tell you of a recent incident that may serve as food for thought. It is the failure of the Iowa poll of 1948 to predict the Republican nominee for governor. The poll indicated 53-58% of the electorate as favorable to Governor Blue whereas the nomination went to Beardsley by 60%. In this instance it is not known how much of the bias can be attributed to interviewer selection and how much was due to changes in intention after the poll was taken. The important lesson to be learned is this: properly designed samples are not vulnerable to this type of interview bias, so that any deviation from prediction, that is, any deviation which turns out to be greater than expected sampling variation, can be used as a measure of change in intention on the part of the voters.

I suspect that every interviewer has his peculiar biases in choosing respondents. Ordinarily there may be compensation among the members of an organization. It is the unpredictable circumstance of accumulation of biases that may cause trouble.

The advocates of non-random sampling often admit the possibility of bias but plead the high cost of random sampling. This may turn out to be the vital question—which method gives the greatest amount of accurate information per dollar spent? It may be that a smaller sample randomly drawn would give the required information at the same or even less expense than the larger sample necessitated by interviewer biases; avoiding, at the same time, the possibility of non-cancelling biases. One advantage of the random sample is that it is essentially unbiased, whereas biases may suddenly and unaccountably appear in any selected sample. This means that randomness in sampling reduces the element of risk. The sampler's reputation is always mortgaged to inevitable sampling variation; why should he stick his neck in the noose of avoidable bias?

So far the discussion has been mainly about sampling from a single population. Many experiments in biology fulfill this condition, at least approximately. Animal and plant populations are fairly stable in many of their characteristics. If one assays the concentration of a vitamin by feeding it to a sample of rats, he has reasonable assurance that the experiment is repeatable next year. Such populations are often roughly normal and do not change notably in time. On the contrary, sampling in economics, sociology and engineering is usually from mixed populations or from those which vary more or less continuously and erratically with time.

If the population is heterogeneous but effectively invariable, it is advisable to design the sampling so as to insure a wide scattering of its elements throughout the

aggregate. This is the opposite of the device that has been widely used in the past where the sampling has been confined to selected segments which are considered "representative". The most extreme case I ever encountered was the complete enumeration of the farms in a single township under the impression that the findings in this 36-square-mile area would apply to the entire state of Iowa. This kind of sample produces all the information about this particular township but no information at all about the rest of the state. Most people, after having their attention called to it, agree that common sense lines up with authentic theory to dictate as wide a scattering of the sample as feasible.

One device for insuring scatter is called stratification. If nothing is known about the composition of the population, mere geographic stratification is advisable: for example, it may be required that some sampling shall be done in every county of a state. But most investigators know a good deal about their populations and use this knowledge to subdivide them into more homogeneous strata. The public opinion polls allocate the sample to strata such as economic level, sex, etc. Rural dwellers are usually put into strata different from urban, while farming areas are separated from industrial. These are all schemes for subdividing a heterogeneous population into more homogeneous sub-populations. After the strata are selected, each should be sampled according to the principles stated before—random drawing with the opportunity of being included guaranteed to every member of the stratum.

The designs which I have been describing insure correct sample-to-population inferences but need some further specification for maximum efficiency. Maximum efficiency can be defined in two ways; the most information for the money spent, or the least cost of a required amount of information. Some organizations, operating under a fixed budget, may be limited to the amount of information they can get for, say, $10,000. They may have to restrict themselves to chosen segments of the population in order to get reliable information about the parts sampled. Other organizations may be more flexible. They may specify a national sample with a certain stated reliability, then enter into a contract to pay the necessary cost. Either way, the efficiency of the sampling is governed by the design.

Neyman, in the Journal of the Royal Statistical Society in 1934, derived two rather simple rules for the efficient sampling of stratified populations. The first is in accord with ordinary good sense, that the sample be allocated in proportion to the size of the stratum. It is assumed that both the variation and the cost per interview in the several strata are the same. The means of the strata may be all different, but there must be a constant standard deviation. If these conditions are met, then proportional sampling is the most efficient.

The strata seldom have identical standard deviations any more than they have the same means. Neyman's second rule is that the intensity of sampling should be proportional, also, to the standard deviation. Suppose, as a fanciful example, one is sampling the electorate in Iowa for the coming election. He has stratified according to economic level and occupation. Consider what might be the outcome in the high economic level among farmers as contrasted with common laborers in industry. Some 90% of the well-to-do farmers might be expected to vote in the traditional manner of our rock-ribbed Republican state, whereas only about 50% of the laborers may follow suit.

Then, according to the well-known formula, $\sigma = \sqrt{pq}$, the standard deviations are respectively 0.3 and 0.5; that is, the second is almost double the size of the first. This means that, for maximum efficiency, the sampling among laborers should be almost twice as intensive as among wealthy farmers. A moments thought will convince you that this also is just good sense. If rich farmers tend to vote alike, then it will take little sampling to evaluate their preference. Among industrial laborers, however, who may differ markedly in their opinions, almost double the sampling rate is required to reach an equally good evaluation. A fantastic extreme is the case in which the investigator might know that all the members of a stratus will vote alike. Clearly, it would be necessary to poll only a single voter to learn how the entire stratum will vote.

This sounds simple but in practice it is not easy. Estimates of population standard deviations cannot be exact. Furthermore, not one but several questions often are asked and no common allocation of the sampling yields maximum efficiency for them all. Here, again, the experimenter in biology usually has the advantage. The standard deviations of many of his sampled populations are known with some fair degree of approximation, and often only one question is asked of an experiment. The reliability of the eventual mean can be predicted with considerable certainty. The experimenter, then, can be quite sure of the money it will take to get an answer of specified reliability; or of the reliability of the answer he can get from expenditure of a specified sum of money. While maximum efficiency can seldom be attained in the sampling of human populations, yet the principles are the same and can be used to regulate the design of such samplings.

A necessary part of any sampling design is the statistical method for summarizing the results. There would be no object in getting information into data unless there were efficient methods of extracting the information for eventual use. For this reason it is worthwhile to consider the formulas applying to a stratified random sample such as we have been discussing. For illustration, the table

Data on Iowa Survey of Food Production in the Home (1943)

Stratum	Number of Families	Weight	Optimum Allocation	Schedules Obtained	Qts. per Family	Estimated Std. Dev.
Urban	312,000	0.445	295	300	165.1	153
Rural	161,000	0.230	159	155	201.4	160
Farm	228,000	0.325	247	237	297.8	175
Total	701,000	1.000	701	692		

Total quarts in Iowa (thousands):

$(312)\ (165.1) + (161)\ (201.4) + (228)\ (297.8) = 151{,}835$ thousands of quarts.

Mean quarts per Iowa family: $\frac{151{,}835}{701} = 217$ quarts

Variance of mean: $(0.445)^2 \frac{(153)^2}{300} + (0.230)^2 \frac{(160)^2}{155} + (0.325)^2 \frac{(175)^2}{237} = 37.84.$

Standard deviation of mean $= \sqrt{37.84} = 6.15$ quarts.

contains the data from a wartime survey of Iowa to learn the extent of the production and preservation of food products by private individuals. I shall use only the results of the question about the number of quarts of food canned, frozen or stored for home consumption.

The rate of sampling was designed as one per thousand families. From the slight amount of information available, we guessed that the variation would be greatest among farm families, so we allocated somewhat more than a proportional number of families to the farm stratum. Results indicated that the guess was good; but the variation proved to be so nearly uniform that proportional sampling would have been satisfactory.

Notice particularly the calculation of the total production, 151,835,000 quarts. The stratum means are used but not the stratum sample sizes. Instead, the stratum sizes or population figures are used. This indicates that moderate deviations from optimum allocations are not important, but that errors in stratum sizes, that is, errors in weights, can be disastrous. This is a point which the poll takers and the marketing research people seem to have overlooked. They insist on adherence to quotas, which is relatively unimportant; but they have no way to make reliable determination of the sizes of strata such as economic levels. Unless the weights are accurately known, the use of strata may be less efficient than completely random sampling. Similarly, it is clear that biases in the sample means in the strata contribute directly to bias in the total, emphasizing the necessity of sound sampling methods.

I have been talking as though randomness of sampling were easy to accomplish. This is not the case in much of our sampling. In a survey of Iowa families, for instance, even if one had all the names and addresses and could select a random sample from it, searching them out in every nook and cranny of the state would be unnecessarily expensive. Experience has shown that it often pays to form clusters of families, then chose a random sample of clusters. There may be a notable saving in traveling expense and little loss due to correlation among individual families of a cluster. Samples of this type are available from a project known as the Master Sample. This was constructed by a cooperation among the Bureaus of the Census and Agricultural Economics together with the Statistical Laboratory of Iowa State College. The materials of the master sample are available to all.

It is of particular interest to observe that a sample designed like that of the food survey, using the materials of the master sample, allows of population estimates without direct use of stratum size. The sample can be expanded from a knowledge of the sampling rates.

So much for fixed populations, whether single or multiple. I turn now for a look at populations in which the variable is changing in time. Public opinion is such a variable, and consumer acceptance is another. The cost-of-living is a third. In fact, most of our economic, industrial and political variables are of this kind. In some, the changes are fairly regular so that trends can be predicted. In many, the changes appear to be erratic.

For these changing populations, efficient sampling designs and statistical methods have not in general been developed. Even the ordinary methods of curve fitting fail because of correlated variances. On this subject, I am not competent to say much. Some progress has been made, but the difficulties are great.

The most successful effort in this field has been in the control of the quality of manufactured products. The reason for the success is that the measurement of quality can usually be stabilized by discovery and adjustment of the operation responsible for poor quality. Here it is not desired to evaluate and predict trends but to eliminate them. Lack of stability is discovered by sampling. The

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The Statistician and Modern Management

by G. L. SEATON
Illinois Bell Telephone Company

Not so many years ago an important part of the statistician's job was to educate management in the uses of statistical method. There was a need to show how statistics could be used in day-to-day operations of the business, particularly in the application of statistical method to the mine-run operating data appearing in reports of business corporations, as well as of many non-business organizations. The complaint of statisticians at that time was that they were not appreciated; that management didn't fully comprehend what the statistician could do to help with the problems confronting them. It was frequently and earnestly argued that there was more to a monthly report of operations than simply the comparisons between the present and the year before; that there were many trends, seasonal influences, casual relationships, and other forces that could be brought out of these figures, and be immensely helpful to management.

The statistician's major task then, in those earlier days, was to broaden the program; to develop examples of how management could make use of the statistician,— of just what practical business uses could be made of the statistical method, — and to convince the doubting Thomases that the statistical approach could be used successfully in solving management problems. In short, the task was to sell management on the idea that the statistician could help to do the job better.

Since that time the field for statisticians has broadened remarkably. Modern management recognizes the value of the statistical method as a means for finding the true answers to many kinds of problems. Of course the precise answer is often unobtainable. In many cases it can be approached but never reached. Nevertheless management is clearly aware that in all cases a better answer can be found with the aid of the statistician than without it.

Truth and reality

But as the job of finding the truth and explaining it continues to become more complex and more difficult, management again casts a doubtful eye at the statistician, for a different reason. Management's big question is no longer 'What can the statistician do for us that we can't do just as well ourselves?"; the question now is, "Do our statisticians have the tools and the capacity and the experience and the persistence and the breadth of vision to seek the truth and to know it when they have found it?"

As far as management is concerned, the proposition is this; that the truth must be in agreement with reality. William James proposed this many years ago, and there were earlier philosophers who stated the same thought. An illustration borrowed from Mortimer Adler points up this proposition. A pencil standing in a glass of water appears bent; however, to the fingers the same pencil seems straight. One sense tells one thing about it, the other tells another thing; but since a pencil cannot be bent and straight at the same time, there must be further examination. In order to understand these contradicting truths and to determine which is the basic truth, there must be an understanding that goes beyond appearances; in this case a knowledge of the field of physics.

In a very elemental sense, that is what is meant by the statement that the truth must be in agreement with reality. Or, put it another way: if the statistician tells his management that such and such a conclusion is the result of certain statistical analyses, he cannot be expected in these days to have that statement accepted or to have money spent on the basis of such a statement, unless he can demonstrate first that his conclusion is in agreement with reality. Or, if he is unable to make a conclusive demonstration of the truth, he must be able to point out where his conclusion may not be in agreement with reality.

Thorough knowledge of data

In order to know whether his findings agree with reality the statistician must first of all know the data. Unless he knows clearly how these basic data are put together, that is, how they actually originate, what they include, what they do not include, and to what extent they actually represent the thing they are supposed to

measure, he is not going to be of much practical help to management. A man does not become a personnel expert by taking personnel courses, important as they are, nor does he become an advisor on customer relations simply by reading books or taking courses in the field of public relations, important as these tools are. He develops capacity in these fields only by knowing very clearly the conditions actually existing among the personnel, or through actually working with customers. A demonstration of a knowledge of statistical method will not be enough to save a situation where the statistician's interpretation has caused management to develop a faulty policy. In whatever field he is operating, the statistician, in order to be of the most help to management, must know without any question the source of his data and the manner in which they are compiled. He must also have at least a working knowledge of the subject or activity that is under analysis.

The days of speaking in generalities, the days of taking someone else's figures and beliefs as a basis for determining a truth, are over as far as the statistician's relationship to modern management is concerned. The methods for determining the percentage of bad rivets, or defective gears, or other physical items of that character, are accepted today without any question. That type of statistical analysis has sold itself; but the wide field of intangibles is something else again.

Working with intangibles

In the telephone business for example there is continuing analysis of the quality of service rendered by telephone business offices. When you call the telephone office to inquire about your service, or to ask a question about a bill, or to place an order to move your telephone, or to make a complaint, the service you get from the girl who receives your call and speaks to you on this matter is measured, and it is expressed in terms of statistics. Also, the manner in which this girl speaks to you, her courtesy, her explanation, your understanding, your acceptance of her service to you, are all measured and explained in terms of statistics. This type of statistical analysis is in a field which requires a great depth of understanding on the part of the statistician if he is to present to management conclusions that will be accepted.

Presentation must be salable

However, the statistician really hasn't gotten anywhere as a statistician until management understands what he has done. He may have the "right" answer, he may have proven to himself that it is in agreement with reality, but unfortunately this information does not become a factor in the operation of a business until it has been presented to management in such a way that they can understand it. The method of presentation must fit the management. Business is carried on by people, it is not carried on by statistics: it is carried on by individuals, and for the most part, they differ just enough from one another to be a problem. Not only does the statistician have to seek and obtain appropriate basic data, plan pertinent analyses, and come up with the right answer, but he also has to study the manager to whom he is going to present his conclusions. It would be hard to say which of these tasks is the most difficult, but it is certainly true that studying the manager in order to determine the character of the presentation is not the least, by any means, of the statistician's problems.

Dressing up a statistical presentation, expending money for art and excellent bindings, does not necessarily increase the chances of having the study accepted. Modern management is not deceived by fancy coverings or gaudy charts; it wants to know the facts carried in the report. However, the truth does deserve a decent dress and the courtesy of a fitting presentation if it is to prevail. Although a fancy presentation does not correct a weak or inept analysis, it is true that a slipshod presentation does reflect unfavorably upon the value and integrity of even the most expert analysis.

Importance of being economical

But finding the answer to a management problem and presenting it in terms of management's needs is not enough. Modern management, it seems, is never satisfied with results as they are. If the quantity and quality of production are good, if the personnel problems are minor, and relations with customers excellent, then the job is costing too much and should be done more economically. Consequently it is important not only that the statistician produce timely and pertinent facts but also that he produce them smoothly and economically. The manager expects not only that the statistician will employ sound methods but also that the analysis plans will be soundly organized, that the procedure of revealing the statistics in their true light will be carefully thought out and will be performed efficiently and without the waste of a lot of money. The statistician who produces the right answers but does so in a disorganized and extravagant manner is very likely to produce also a new statistician.

The statistician, then, has attained in the eyes of management a new professional status as one who is able to find the truth. The attitude of the statistician, therefore, must continue to be one of devotion to truth. But a statistician who draws conclusions without a thorough attempt to show that what he believes to be the truth is in agreement with reality, would be doing a disservice to the profession, as well as to his management. The job of the statistician will become even more valuable and more difficult as the importance of truth receives greater and greater recognition. It must receive that recognition because that is the only basis upon which management can succeed in the long run.

Collecting Statistics in China

by D. K. LIEU
Commercial Counselor of the Chinese Embassy and
Chinese Representative on the U. N. Statistical Commission

Since the Chinese people are not used to answering statistical inquiries, we have developed a certain kind of technique in collecting statistical data which may be described under the following headings:

The interviewer

The interviewer need not have college education but he must have special training for the purpose. The following are his requirements:

(a) Knowledge of the particular subject for which he collects statistical data. This knowledge may not be exactly the same as that in the Western countries. For instance, in conducting a survey of cotton mills the interviewer must know not only the various kinds and makes of machinery commonly used in China and the processes of manufacturing but he must also be familiar with the general way of calculating the quantity of yarn that can be produced from a certain quantity of cotton. In the production of polished rice he must know the quantity that can be obtained from a picul of paddy. These ratios may not be the same as those in the West since the production process is often simpler and the quality of the raw materials different. He must also know the productive ability of the average Chinese worker, and there are certain simple ways of figuring out the unit labor cost in various industries. If it is census enumeration, he must know, for instance, the usual classification of occupations in the locality. A cabinet maker may be known as such in one locality and as carpenter in another.

(b) In addition to such knowledge he must also have good judgment in order to determine if the information obtained, when it differs from what we may call the norms, is or is not due to some special causes, such as better equipment or greater productive ability of the worker, etc. There are naturally deviations in many cases and he needs judgment to determine if the deviation is within reasonable range.

(c) The interviewer must have a very good memory. In many cases he would not be able to obtain any information at all if he should take notes of the answers. The information has to be obtained in the course of general conversation, and when a notebook is produced, the respondent would often refuse to talk any more. There are of course exceptions, but usually the interviewer has to remember all the answers he has obtained and write them out after he has returned to his own place.

(d) The interviewer must have a pleasant personality. This I believe holds true also in the West, but in China it perhaps means more because the interviewer has to win the confidence of the respondent. He must not say anything to antagonize the latter even though he knows an answer to be inaccurate. The only way to obtain a correct answer is to put the question in a different manner after a little interval and try to make the respondent understand what information is really wanted, or catch him unawares if he is unwilling to give correct information.

The respondents

The interviewer must choose his respondents, which sometimes makes random sampling very difficult. Sometimes he has to obtain proper introduction, especially in rural surveys, from the heads of the *pao* or *chia* (*pao* and *chia* are composed of a number of families). If he gets along very well with these people, they will be in a position to supply him with much information about other members of the *pao* or *chia*, as well as introduce him to those who are willing to supply further information. In a study of Wuhing rural economy some years ago, I found that there were different types of families, some of whose members were engaged in sericulture, others in sericulture as well as silk reeling, still others in both of these and silk weaving, and finally those that were engaged in sericulture and fishing at the same time. By fishing is meant that they raise fish in ponds near their farms. Most of them were at the same time engaged in farming. In order to choose samples from different groups of people who were engaged in a combination of occupations, the interviewer had to obtain a preliminary idea of the distribution of such groups in the county from the heads of the *pao-chia* and from the primary school teachers. From these people the interviewer also ascertained beforehand the respondents who would be willing to supply information and supply it accurately.

The approach

Proper introduction as mentioned above is usually necessary. In other cases the interviewer has to try to engage in conversation with the respondent under some excuse, such as asking for the way to a certain other village, or talking about the weather, or asking about the number of inhabitants in the village which he is visiting. Usually he has to talk a good deal about general topics, partly to

show that he understands the conditions in the region and partly that he is interested in acquiring new knowledge. It will not do for him to make it plain that his interest is to obtain statistical information. When the conversations run smoothly, the respondent will often volunteer information which is unexpected, but which gives important background data. Usually the interviewer has to be very tactful in leading the conversation back to the topics about which he is gathering statistical information, when the respondent talks too much at random.

It will not do for the interviewer to ask one question after another even when the respondent has shown a willingness to talk. It is usually a good practice to sandwich his question among a general discussion of other topics. This requires a good deal of tact and patience on the part of the interviewer, but it usually produces the best results. Sometimes several questions worded differently have to be asked in order to obtain one answer, if the first or first few answers are not satisfactory. In such cases these questions, as has been pointed out above, must not follow one after another, but other questions or general discussion should intervene in order to take the respondent off guard, or to make him understand exactly what information is wanted. As a rule, the respondents will give truthful replies, but if they are not approached properly they may either refuse to answer or give anything for a reply, just to get rid of a bore.

The interviewer should, whenever possible, be prepared for the interview by obtaining information from indirect sources beforehand. For instance, if he wants to interview the manager of a factory, he should first find out from several other factories, usually of the same industry, the general conditions in the industry and the factory concerned. When he has such general knowledge, especially of that particular factory, it is easier for him both to carry on a general conversation with the manager and to check upon the accuracy of his answer. This does not mean that information obtained by indirect methods is always reliable, but it gives him some sort of background about the factory concerned. The same holds true with obtaining information from farmers. This kind of preliminary information may sometimes be obtained from research reports, statistics of previous periods, etc.

One single respondent may have to be approached more than once. It may be because the person is too busy to spend enough time with the interviewer or unwilling to give any information during the first interview. If the interviewer is tactful he will soon establish a sort of reputation as a good fellow in whom one may confide. When that is the case, any particular respondent who has been unwilling to talk may find out from other respondents that talking with this particular interviewer will do no harm, and he will usually be more frank during the second or third interview.

If written schedules are sent to the respondent, which is only done in the case of large companies, it usually requires follow-up work by personal calls on the part of the interviewer. Follow-up letters sometimes help, but are not of much use in China.

The usual way of preserving secrecy in the West by leaving out the name of the respondent or that of his firm can seldom be adopted in China. The Chinese respondent is not in the habit of mailing in questionnaires, and even if he cares to do so, he will thank that the number or some identifying mark on the questionnaire will "betray" him. Either he will talk quite freely, if the interviewer approaches him in the proper way, or he will not supply any information, no matter how much secrecy is promised.

In some cases some sort of pressure has to be exercised on the respondent. The pressure must not be so great as to make the respondent feel he is under compulsion to supply information, nor should it be so slight that he may disregard it entirely. It need not be from official sources. A field worker of a private research institute may also exercise such pressure if he knows how to handle his respondents. It consists in the tone of the conversation, the way he behaves and other indefinable mannerisms.

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Sampling Investigations

CONTINUED FROM PAGE 9

engineer then seeks the cause or causes of excessive variation and takes steps to remedy the defects in the production line. Once the quality variable is under control, the characteristics of the stable output population are determined. These can be made the basis for contracts safeguarding the interests of both producer and purchaser. The sampling designs used in quality control are rather simple and have become astonishingly popular. Their widespread use is almost certain to be followed by the rapid introduction of other sampling and experimental designs into industry.

The sampler of public opinion or consumer acceptance may take successive samples in order to learn of changes that may be going on in the population. He should always be careful to designate the date of a sample and avoid any implication that the facts apply to any other date.

Since sampling has transcended the routine of everyday living and has become economically, socially and politically momentous, it behooves us to examine and reexamine our sampling procedures to make sure that they are not only competently executed but also theoretically sound.

FAO's Program for Statistical Training

by CONRAD TAEUBER
Head, Statistical Standards Branch
Economics and Statistics Division, FAO

Improvement of national statistics relating to food and agriculture is one of the assignments given to the Food and Agriculture Organization of the United Nations, and a number of steps to accomplish that assignment have been taken. One of the major efforts has been the encouragement and establishment of a number of training centers in different parts of the world. The training centers established to date have been for short terms, one lasted six weeks, the others four months. Major emphasis has been placed on giving the students practical training in techniques adapted to the conditions in which they will be working.

These training courses have taken as their point of departure the preparations for the 1950 World Census of Agriculture. However, since that census is conceived of as an integral part of a program of improvement of statistics of agriculture generally, these training courses have been concerned with the problems encountered in developing and maintaining an adequate program of national statistics of food and agriculture.

In many countries there is a real shortage of adequately trained statistical personnel, and many persons who are responsible for carrying out statistical programs have not had the opportunity of technical training. The training projects already carried out have endeavored in part to fill the needs that exist but obviously they cannot take the place of thorough theoretical training in the field of statistics. Rather it is the intention: (1) to improve the statistical tools with which the students work and to give them a greater familiarity with the whole range of tools that is available to statistical workers; (2) to give them a better appreciation of the problems which they are equipped to handle and the other problems for which they need technical assistance and to give them an idea of how to secure the required technical assistance; (3) to increase the extent to which all figures are critically evaluated and the methods by which verification of available figures can be carried out; and (4) to give a greater appreciation of the utility of statistics and the methods by which the statistical materials can be made more useful to administrative work.

One related purpose has been to stimulate some of the individuals who have been placed in statistical positions to secure the more thorough theoretical training which they need.

In the Near East

The first such school was established in Baghdad about the middle of March. Thomas C. M. Robinson, a member of the staff of the Bureau of Agricultural Economics in Washington, was detailed to FAO for the duration of the school. He served as the chief instructor. Before the school began he had been given an opportunity to consult with individuals in some of the national statistical offices in the Near East to give him an opportunity to relate the training program directly to the conditions of those countries.

The Government of Iraq offered physical facilities for the school, provided local transportation and made housing facilities available. They also provided bi-lingual staff members who assisted in presenting some of the materials in Arabic and in translating directly the English lectures and assignments for the benefit of those students who were not fluent in English. Forty students from four countries participated in the course. They included individuals from national as well as provincial statistical offices. The background of the students was varied both with respect to academic training and their understanding of English. Each government assumed responsibility for transportation of its trainees between the home country and Baghdad and for the subsistence of the trainees while in Baghdad.

Approximately two-thirds of the time was spent in teaching basic techniques and the remainder of the time was given over to a discussion of sampling and of possible solutions to the actual problems of agricultural statistics in the Near East. The lectures have been duplicated and copies made available to the students. Each student who successfully completed the course, including the examinations, was given a certificate to that effect.

Most of the trainees who participated in the course are responsible for some phase of the statistical work relating to agriculture in their home countries and a few received this training as a preliminary to assuming such a position. One of the students who participated in the course recently arrived in the United States for more thorough academic training.

There has been some discussion of the desirability of repeating this course and of offering an advanced course which would carry the students somewhat farther than this first effort was able to do.

In China

In preparation for its 1950 Census of Agriculture the Chinese Government has started a training class in agricultural census methods in cooperation with FAO. The thirty trainees are recruited, one from each of 12 provincial agricultural departments, from each of 12 provincial statistical departments, and the remainder from offices in the central government. The trainees are persons who are expected to have responsibility for the 1950 Census work in their provinces. They will also be expected to train subordinate personnel.

The instruction is carried on in Chinese. A handbook of statistics of agriculture and forestry which was recently prepared in the Chinese language by the Ministry of Agriculture and Forestry gives the trainees a guide to the statistical materials currently available. The instructors are recruited from the responsible national offices concerned and Nanking University; FAO has supplied two instructors, one of whom is fluent in Chinese. The training program consists of (1) a period of class room and laboratory instruction dealing primarily with census procedures, census schedules and statistical methods relating to census problems; (2) an experimental census in one county including approximately 75,000 farm households; and (3) a statistical analysis of the results and the preparation of a report on the experimental census. The class room work includes an analysis of agricultural censuses conducted in other countries, census techniques, census schedules, census organization, statistical methods, rural economics, and some lectures on the organization of agriculture in China. As part of the laboratory work the schedule to be used in the experimental census is being developed.

In Latin America

The Centro Latinoamericano de Capacitacion Estadistica y Censal for Latin American workers was established in Mexico City early in September 1948 and is to continue until mid-December. This center was established jointly by the Government of Mexico and the Food and Agriculture Organization. The Statistical Office of the United Nations and the Inter American Statistical Institute are cooperating in supplying instructors and materials. At the request of the Mexican Government a number of members of the staff of the U. S. Bureau of the Census are participating as instructors; the Bureau of the Census has also made available one staff member to FAO and the Governments of Cuba and Panama are making staff members available to assist in the training program. Six countries are represented on the instructional staff.

Because many of the governments in Central and South America are planning censuses of population and of agriculture, it was arranged to have the school deal with both subjects. Some courses, i.e., sampling and census administration, are given to the groups jointly, but for others the group is divided into two parts.

Sixteen Latin American countries have sent fifty-five students to the center. The Government of Mexico is providing the necessary facilities, some instructional staff, the clerical staff, equipment, and assistance to the students in finding housing. The governments are paying the transportation and subsistence of their own trainees but there is no charge for tuition. Through the generosity of some Mexican citizens it was possible to assist a number of trainees whose governments were unable to meet the full costs.

With very few exceptions, the trainees present in Mexico City are persons who are responsible for statistical activities in their home countries. Their positions are covered by such titles as: Director General of Statistics; Chief Statistician of the Agricultural and Livestock Department; Chief of the Agricultural and Statistical Department; Assistant to the Director General of Statistics; Statistican, Department of Agriculture; Assistant, Tabulation Department of the Central Statistical Bureau. Two of them are advanced students and a few others are persons who are expected to assume responsibility for statistical work on their return.

The trainees were selected by their own governments. The minimum qualifications were stated as follows:

> "Trainees should have had a previous education covering at least the field of Liberal Arts, particularly arithmetic and algebra, and general knowledge of statistical practice and theories; and persons selected for training in agricultural statistics and census should preferably be agricultural engineers or rural economists, or should at least have general knowledge of agricultural matters."

For the first four weeks the courses offered consisted of a review of essential mathematics and statistics. Then attention was given primarily to the theoretical and practical aspects of censuses of agriculture and population, with special attention being given to the practical application of the subject matter presented. Emphasis is placed on "laboratory work," in which the students are given an opportunity to apply the materials presented in formal class periods and in seminars. In addition there are courses in sampling, in census administration and procedures, in labor statistics and cost of living indexes, and in current agricultural statistics. The students are expected to develop proposed schedules and procedures for the 1950 censuses of population and agriculture in their countries, using as basic materials the lists of items proposed by the Committee for the Census of the Americas of the IASI in regard to population, and by the FAO in regard to agriculture.

CONTINUED ON PAGE 18

QUESTIONS and ANSWERS

edited by FREDERICK MOSTELLER
Harvard University

PREDICTION OF ACTUAL SALES AND PROFITS FROM ESTIMATED RESULTS

Question 16. Our organization consists of three units, each supplying sales and profit information to a central office. Since it requires about 18 days after the end of a month to obtain the actual sales and profit data relating to that month, each unit is requested to furnish estimates of sales and profit on the last day of the month. About 18 days later actual sales and profit information is received from each unit.

My problem may be sub-divided into two parts:

a. To compare the estimates with the actual submitted by each unit and to develop a measure of accuracy from such a comparison.
b. To develop a "prediction measure and/or factor" (separately for each unit) so that the central office may predict the actual results from the estimates submitted by the unit.

I am appending 9 months data of sales and profit for two of the units (of necessity, these are hypothetical, but they reflect the original data very well).

ESTIMATED SALES AND PROFITS COMPARED WITH ACTUAL RESULTS
January to September

Unit No. 1

	Sales		Profit	
	Estimate	Actual	Estimate	Actual
January	$1,402	$1,546	$ (19)	$ 91
February	1,468	1,608	9	102
March	1,737	1,724	91	44
April	1,715	1,638	110	68
May	1,903	2,063	18	167
June	1,816	1,832	148	182
July	1,422	1,461	20	(23)
August	1,559	1,655	(14)	3
September	1,417	1,527	(63)	(57)

Unit No. 2

	Sales		Profit	
	Estimate	Actual	Estimate	Actual
January	$ 450	$ 495	$(39)	$ (5)
February	440	479	(12)	(3)
March	475	531	3	15
April	560	578	25	23
May	590	641	25	37
June	525	540	11	13
July	483	496	(12)	0
August	526	541	10	30
September	522	520	20	4

( ) indicates loss

Answer. It is somewhat hazardous to recommend an analysis for actual data when the analysis is based upon hypothetical data. However, I shall attempt to present an approach to this problem of predicting actual sales and profits from estimated results. First, one should examine the nature of the differences between actual and estimated results. Ordinarily we prefer to use logarithms of the ratios for price data, but the variation in the hypothetical data for each unit seems to indicate that differences are satisfactory if unit[8] are not pooled. In other words, most estimates would be expected to deviate more at high price levels than at low ones; hence log ratios would be more likely to have constant variances from observation to observation than would differences. I have discussed this problem in a recent article in the Journal.[1]

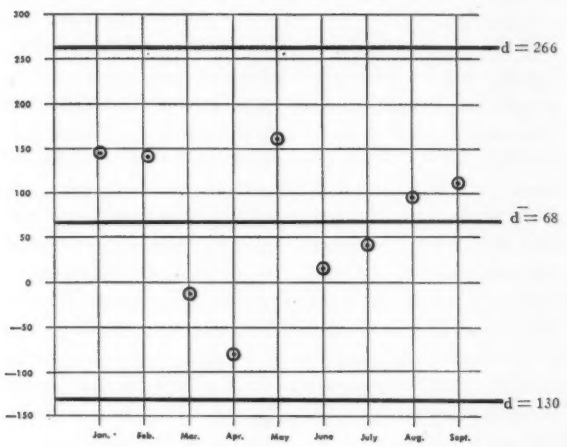
I shall illustrate various predictive equations with the sales data from Unit No. 1. The differences, d, between the actual sales (A) and the estimated sales (E) are

144, 140, −13, −77, 160, 16, 39, 96, 110.

These differences have been plotted in Figure 1.

FIGURE 1

DIFFERENCES BETWEEN ESTIMATED AND ACTUAL SALES



If we assume that the differences (d) have a mean of 0 in the population, we would continue to use the estimated sales as the best prediction of actual sales in the long run. Then about half of the differences should be above and half below the line $d=0$ in Figure 1. The 9-month's data indicate that there is a rather definite underestimation of actual sales. The average amount of this underestimation is the average difference $\bar{d}$ = \$68. We note that 5 differences are above and 4 below this average line. I recommend that you adjust upwards your estimates of sales by \$68 but that you continue to plot your data on a chart of this kind to note any needed changes in this adjustment.

In order to measure the accuracy of any given method of prediction, I ordinarily recommend the standard error of prediction (s), which is computed as $\sqrt{\Sigma e^2/n}$ using a mean of 0, and

$$\sqrt{\left(1 + \frac{1}{n}\right) \Sigma e^2/(n-1)}$$

for a mean of $\bar{d}$, where the e's are the deviations from the prediction line.[2] For the mean of 0, the e's are the same as the

[1] Use of Variance Components in the Analysis of Hog Prices in Two Markets *Jour. Am. Stat. Assn.* 42: 612–634 (1947).

[2] An easier estimate to compute is the mean absolute deviation = $\Sigma|e| / n$ = \$88 for a mean of 0 and \$69 for a mean of $\bar{d}$. A better estimate in the second case probably would be $\Sigma |e| / (n-1)$ = \$77.

differences; hence $\sum e^2 = (144)^2 + \ldots + (110)^2 = 95127$ and $s = \sqrt{95127/9} = \$103$. Using $\bar{d}$ as the estimated mean, the e's are 76, 72, −81, ..., 42; hence $\sum e^2 - (76)^2 + (72)^2 + \ldots + (42)^2 = 53103$ and

$$s = \sqrt{10\ (53103)/72} = \$86.$$

The industrial statisticians have developed a control chart method of determining if future results seem to conform to the earlier ones. This control chart consists of the mean line with a line above and one below this mean line, so constructed that if the estimation procedure remains unchanged, the chance of a difference falling outside these two outside lines is, say, 5%. If we use $\bar{d} = \$68$ as the mean line, the 5% bounding lines would be $\$ [68 \pm (2.3)(86)] = -\$130$ and $266, where the factor 2.3 is the value of t at the 5% level. If future differences begin to fall outside these lines, or if more (or less) than half the values fall above $\bar{d}$, some adjustment in the mean probably is called for.

If the cyclic nature of the differences continues, I would advise refining the prediction somewhat as follows:

$$d_1 = \bar{d} + b \sin \frac{2\pi i}{P},$$

where P is the period of the fluctuations. For these 9 observations it would appear that $P = 4$ months. It is very hazardous to estimate a cyclic phenomenon from only 9 observations, but there are reasons to suspect that the accuracy of the estimator tends to be of a cyclic nature. Another means of considering the fact that past performance may influence the present estimate is to use a prediction equation of the type

$$d_t = a + b\, d_{t-1} \text{ or } d_t = a + b\, d_{t-2},$$

where the difference at time t is estimated from that at some previous time ($t-1$ or $t-2$). Again more data would be needed to estimate the constants a and b.

In all of these cases, I have assumed that the adjustment from estimated to actual sales was an additive constant. Perhaps it is a multiplicative constant, so that the adjustment is larger for larger sales. In this case we might consider using a prediction equation of this type:

$$A = bE \qquad \text{or } A - \bar{A} = b'(E - \bar{E})$$

where A is actual and E expected sales, and b and b′ represent the multiplicative factor to inflate the estimated sales in predicting actual sales. We note that the two equations are the same except the second involves deviations from the means of A and E. The value of b is computed as $\sum AE / \sum E^2$ and the standard error of the prediction is

$$\sqrt{(1 + E^2 / \textstyle\sum E^2)\,[(\sum e^2 / (n-1)]}$$

where $\sum e^2 = \sum A^2 - b^2 \sum E^2$. In this case the standard error of prediction is different for each E, the average for the sample being about

$$\sqrt{(1 + 1/n)\ \textstyle\sum e^2 / (n-1)}.$$

For the sales data at Unit No. 1, $b = 1.0404$ and the average standard error of prediction is about $89. The computations for b' are the same except that deviations from the means are used and the standard error of prediction is

$$\sqrt{\left[1 + \frac{1}{n} + \frac{(E - \bar{E})^2}{(E - \bar{E})^2}\right] \sum e^2 / (n-2)}.$$

A control chart corresponding to Figure 1 can also be constructed using either of these equations. This is illustrated in Figure 2 for $A = bE$. Again you should examine future results to determine if the prediction equation needs correcting.

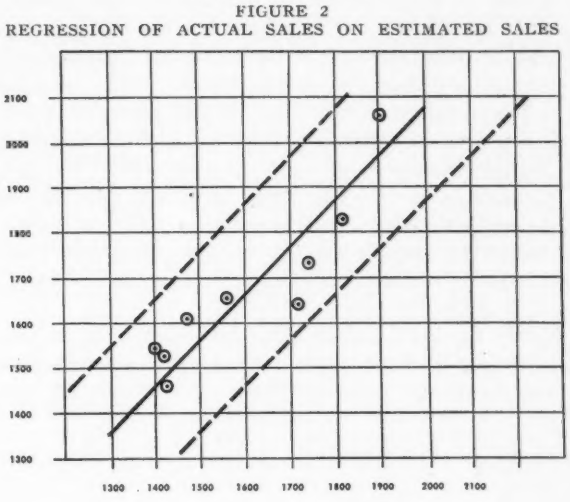


FIGURE 2
REGRESSION OF ACTUAL SALES ON ESTIMATED SALES

The standard errors of prediction for all four sets of data are:

		PREDICTION EQUATION		
Data	$d = 0$	$d = \bar{d}$	$A = bE$	$A - \bar{A} = b'(E - \bar{E})$
No. 1 Sales	103	86	89	92
No. 1 Profits	75	76	83	81
No. 2 Sales	34	21	22	23
No. 2 Profits	16	15	16	12

We note that the standard errors are of the same order of magnitude as the sales values; hence, separate predictions must be made for each unit unless log ratios are used to equalize the standard errors.

R. L. Anderson

EDITORIAL

CONTINUED FROM PAGE 1

debt is owed the wartime operations research teams for demonstrating the power of the integrated scientific approach to broad management problems.

Some of the newer methods that operations research teams would certainly use in solving peacetime management problems in business, industry, and government, are sample surveys in marketing, statistical quality control in production and inspection, aptitude testing in personnel selection, opinion surveys in guiding labor-management relations. And now such developments as Von Neumann's theory of games, Leontief's input-output concepts, Shannon's theory of information, and Wald's theory of

decision promise new scientific tools for the analyst to use in this rapidly developing field of modern operations research. Future teams will need to have men of many talents if full and effective use is to be made of such varied tools in the solution of management problems.

During World War II, these teams of specialists functioned in a highly effective manner as staff advisors who participate in the discussion, recognition, and formulation of high-level operational problems. One of the most significant aspects of operations research was the close association between scientists and high military officials even though the former functioned in a strictly advisory capacity. Operations research specialists believe that a similar organizational structure would be fruitful in relation to business and industrial management.

The organization of this activity on a large scale poses a major training problem. It is not merely a matter of finding specialists thoroughly familiar with their own particular segment of scientific knowledge, but also of training researchers to solve problems which cut across the various scientific compartments. Speaking before the Institute of Aeronautical Sciences in June, 1946, General H. H. Arnold stated:

"Rare was the scientist whose interests led him to consideration of what I may call diffuse problems, connected with operational research. The number of scientists and technologists who applied themselves to the solution of the difficult problems associated with operations was pitifully small. I suspect this failure is a reflection upon our method of training. It seems to me that we must do something to encourage greater interest in the application of the method of reasoning to the evolution of problems which deal not only with machines, but with the integrated combination of men and machines."

Devising a system of formal training for these "diffuse problems" is a challenging undertaking. We believe that statistical methods play a unique role in these newer techniques. Probably the strongest bond of interest for those who work in operations research is the fact that a substantial part of their activity consists of statistical analysis, as applied to the collection, analysis, and interpretation of observed data.

The American Statistical Association and its chapters can bring together locally, regionally, or nationally, groups of persons with a common interest in operations research problems. The Association has a tradition of more than a hundred years of bringing together experts and students to discuss problems of applying statistical method in new and evolving scientific areas. The responsibility which the Association faces in the field of operations research is another stimulating challenge.

THE EDITORS

FAO's Program CONTINUED FROM PAGE 15

An experimental census of population and an experimental census of agriculture are being conducted as part of the program, using an area near Mexico City. Following these field experimental censuses the students will be reassembled in Mexico City and have an opportunity for critical examination of that experience and of the results secured.

Most of the instruction is being given in Spanish, and arrangements have been made for translation of those lectures which cannot be given in Spanish. All of the lectures are being recorded and will be duplicated and made available to the students. In that way the students will have available in their home countries the materials presented at the center as an aid in carrying on the further training programs which will need to be developed within the countries as part of the work for the 1950 Census.

Additional training centers are contemplated, though no further arrangements have been completed. It is hoped that such a center can be established for countries in South East Asia, where considerable interest in such a project has been shown. There have also been some requests from a number of European statistical offices for assistance in developing similar programs. In carrying forward this work it is planned to continue to work cooperatively with national offices and to utilize training facilities that already exist within a region. Efforts are also being made to facilitate the more basic training of statistical workers, through the use of facilities existing in government offices and in universities and institutes. Cooperation with other interested international agencies will be developed wherever feasible. Consideration is being given also to the possibility that when the first round of such training centers has been carried through it may be desirable to establish training facilities which will be more readily accessible to workers in provinces and districts than has been the case so far.

Graphic Representation for Multiple Linear Correlation

by GEORGE URI,
Shell Oil Company

The results of correlation analysis are often intended for the eyes of the "non-statistician" as well as for those of the statistician. The problem, then, is to furnish a clear general picture and no more than that. Unnecessary detail tends to provoke understandable impatience.

The conventional solution[1] is a tabulation of estimated values calculated from the regression equation, showing various combinations of the independent variables. But even the best of tables is uninviting reading matter and, for most readers, is not as easy to interpret as a graphic portrayal of the same data.

A simple method of graphic presentation is shown here. It is an application of the familiar band or strata chart. The estimate is shown as the sum of the weighted values of the components from which it is made. By this method the reader intuitively grasps the very natural idea of several forces combining to determine the estimate. It is also easy to observe the closeness, or lack of closeness, of the estimated figures to the actual. The extent to which the actual and estimated series correspond graphically, clearly indicates the degree of correlation. Arrangement of the data as a time series is advantageous not only for the possible light that may be thrown on year to year changes in the data, but also because it automatically answers the typical question: What happened in that year?

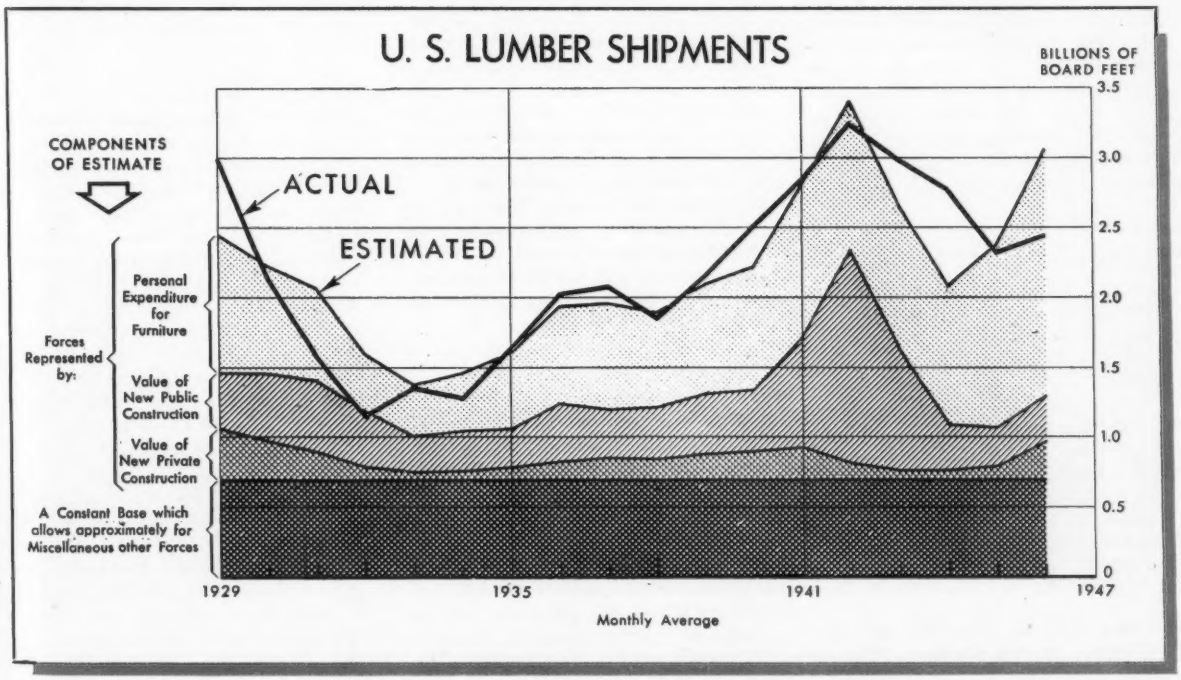
The method of preparation is simple. An equation showing the relationship between the dependent series and those with which it is correlated is a by-product of the ordinary correlation analysis. In the illustration, the equation was of the following form:

Shipments of lumber = A constant + (a weight × value of new private construction) + (a weight × value of new public construction) + (a weight × personal consumption expenditure for furniture).

The value series used have been deflated by building materials and house-furnishings price indexes. The constant, which is a balancing factor in the equation, gives the height of the lowest band. The height of the band for private construction is equal to that series multiplied by the appropriate weight from the equation. The two remaining bands are plotted in the same way. The result is that the total height of the four bands adds to the estimate of lumber shipments.

By the use of this chart, the influences of the changes in private and public construction and furniture consumption on lumber shipments may be readily seen.

[1] See Mordecai Ezekiel, *Methods of Correlation Analysis*, 2nd ed., pp. 205-206; John Wiley & Sons, New York, 1941.



NEWS about MEMBERS

A **Franz L. Alt** has left the Ballistic Research Laboratories at Aberdeen and joined the National Bureau of Standards where he will be in charge of the Computation Laboratory of the "National Applied Mathematics Laboratory". **Henry B. Arthur** has been serving since September as chief of the Office of Program Review and Recovery Progress in the Paris Office of the Economic Cooperation Administration. He is returning to his duties as Economist for Swift & Company shortly after the first of the year.

B **Raymond V. Bowers** has been appointed Executive Director of the Committee on Human Resources, Research and Development Board, National Military Establishment. **Dorothy S. Brady** has resigned from the Bureau of Labor Statistics where she was employed as Chief of the Branch of Cost of Living, to join the faculty of the University of Illinois in a research - teaching position. **Herman Bergman**, formerly with the Port of New York Authority, is now employed as a Statistician in the Research and Statistical Branch, Industrial Planning Division, Air Material Command, Wright Patterson Army Air Base, Dayton, Ohio.

C **Herbert S. Conrad** has been appointed Chief of the Research and Statistical Service, Division of Central Services, Office of Education. He was formerly with the Educational Training Service in Princeton, New Jersey. **John H. Curtiss**, Chief of the National Applied Mathematics Laboratories of the National Bureau of Standards, is in California where he has assumed temporary additional duties as Acting Chief of the Institute for Numerical Analysis.

D **Helen Demond**, formerly with the National Income Division, Office of Business Economics, has transferred to the Economic Cooperation Administration.

E **Edgar I. Eaton**, formerly of the Bureau of Labor Statistics, Division of Prices and Cost of Living, is now chief of the Branch of General Price Research and Indexes.

F **Marvin W. Farrell** completed his studies for a Ph.D. in economics at Harvard University in September 1948, and is now an associate professor of agricultural economics at Ontario Agricultural College. **Milton C. Forster** is now Acting Chief at the Veterans Administration.

G **Ronald Gardner**, formerly with the foreign service of the State Department, has been appointed statistician in the National Income Division, Office of Business Economics. **Milton Gilbert** has taken a two year leave of absence from the Bureau of Foreign and Domestic Commerce and has gone to Paris where he will serve as Director of the Research and Budget Department of the American-Jewish Joint Distribution Committee.
John Gurland received his Ph.D in in Mathematical Statistics at the University of California last August and is now a Benjamin Pierce instructor in mathematics at Harvard University.

H **Frank A. Hanna** has resigned his position as economist in the Industry Division, Bureau of the Census, to accept a position at Duke University. **Walter A. Hendricks** left for Germany in September to complete the analysis of data collected during the summer from surveys designed to measure the yield of winter rye, winter wheat and potatoes, and to make an objective check of the land utilization census. Mr. Hendricks has been on loan to the Army for this work in Germany, and is returning to his regular duties with the Bureau of Agricultural Economics. **Max A. Hirschman**, formerly Chief Economist, Hardwood Lumber Price Section, OPA, has accepted a two-year position with the Land and Claim Commission, Department of the Navy, Guam. **Abner Hurwitz**, formerly Chief of the Cost of Living Index Section, Bureau of Labor Statistics, has been named Chief of the Branch of Cost of Living.

J **Raymond J. Jessen** spent the summer in Greece with other members of the U.S. Department of Agriculture and Statistics Laboratory, Iowa State College. He served as Statistical Director for the Rockefeller Foundation survey for obtaining information of an economic, social and cultural nature to be used in planning broad social programs for the betterment of Crete, the island chosen for testing purposes.

M **Robert J. Meyers**, Assistant Commissioner, Publications and Program Planning, Bureau of Labor Statistics, is on leave as economic adviser to the Economic Cooperation Administration mission for France, and is stationed in Paris. **Robert J. Myers**, Chief Actuary of the Social Security Administration, Social Security Ad-Administration, attended a meeting of the Actuarial Subcommitee of the Correspondence Committee on Social Insurance of the International Labour Office in Geneva in September. From Geneva he went to Athens to furnish actuarial assistance on the Greek social insurance program, at the request of the Social Security Administrator for Greece of the American Mission for Aid to Greece. **Walter Mitchell, Jr.**, Managing Director of the Controllers Institute of America, has also been appointed Research Director of the Controllership Foundation. The Foundation is

devoted to research in financial management and related subjects which affect the health and growth of American Business.

Simon Naidel is working as an economist with the Bureau of Community Facilities of the Federal Works Agency and is lecturing on economics at American University.

A. Ananthapadmanabha Rau, who has been studying at the Statistical Laboratory in Ames, Iowa, has returned to India to head the Departments of Statistics and Agriculture Meteorology of the Government of the State of Mysore, India. He will work on sampling design of experiments, climatology, and will teach statistics and climatology at the College of Agriculture. **Margaret G. Reid** has resigned as Head of the Family Economics Division, Bureau of Human Nutrition and Home Economics, to join the faculty of the University of Illinois where she will teach in the field of consumption economics.

Charles F. Sarle, Head of the Division of Special Farm Statistics, BAE, has just returned from Japan where he assisted in improving crop estimating techniques and procedures and in setting up an objective method of sampling Japanese agriculture. He was on loan to the Army for this assignment. **Douglas E. Scates** has left the University of North Carolina to work with the American Council on Education. Dr. Scates is working on a special study that the Council is doing for the Scientific Personnel Division of the Office of Naval Research.

Paul Wiers of the Division of Statistical Standards, Bureau of the Budget, is on 2-months loan to the United Nations Statistical Office where he will work on plans for special foreign trade publications. **Robert F. Winch** has been appointed Professor of Sociology at Northwestern University. Professor Winch will offer both graduate and undergraduate courses in statistics, scientific method, and the sociology of the child.

Boris S. Yane is teaching at the School of Foreign Service, Georgetown University, Washington, D. C., in addition to his work at the Bureau of Labor Statistics. **Nicholas Yaworski,** economist in the Industry Division, Bureau of the Census, has transferred to the U. S. Tariff Commission. **William J. Youden** has joined the staff of the National Bureau of Standards as Assistant Chief of the Statistical Engineering Section. He will act as special advisor to the Director on the problems of statistical and mathematical design of major experiments in physics, chemistry, engineering.

Deceased:

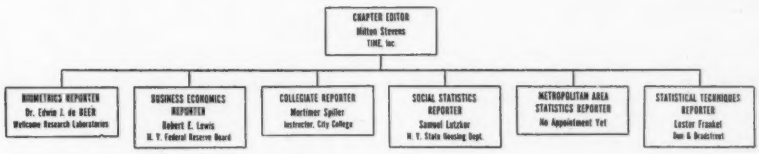
Valentino Dore
Wesley C. Mitchell
Douglas Oberdorfer

Perspective from NEW YORK

by Milt Stevens

This marks the second year of the revitalized program of the New York Chapter. We have told you about the reorganization which brought with it regular meetings, good attendance, functioning committees and specific projects like the Research Center.

This column will report regularly the goings-on in New York. Because of the diversity of statistical interests in New York, it is impossible for any one person to actively cover all phases of this work with equal facility. We have, therefore, organized a reporting system to get more effective coverage of all statistical specialties.



This organization is a direct outgrowth of the six functioning divisions of the New York Chapter. The reporters will cover meetings in the field of their specialization. Since each is a recognized statistician in his own field he will also be able to unearth local news of national interest for reporting in this column. Lastly, he will try to stimulate other members to write articles for The American Statistician. Here are a few indications of things to come from New York this season.

The Biometrics Division, Dr. de Beer reports, is composed of a small group of "diehards" who meet one evening every month. Besides these regular meetings there are special sessions at which well-known experts speak. Professor J. H. Gaddum of Edinburgh is on the docket to talk on "Toxicity Studies". The New York Academy of Sciences has scheduled a conference on the "Application of Statistical Methods to Biological and Chemical Sciences" for January 28 and 29, 1949. Negotiations are now under way to allow the American Statistical Association and the Biometrics Society to be joint sponsors of the conference.

The Business Economics Division has scheduled its main Fall meeting for December 2, 1948, as a business forecast session. A panel of prominent speakers will present the viewpoint of the industrialist, the banker and the professional economist. The speakers will be announced later.

All members are invited to contribute news items to any member of the editorial group for reporting here.

CHAPTER NOTES

BOSTON

President: Professor Charles A. Bliss, Graduate School of Administration, Harvard University, Soldiers Field, Boston.
Vice President: Roswell F. Phelps, Director, Phelps Statistical Service, Boston.
Secretary: Dr. Wilfred S. Lake, Dean, College of Liberal Arts, Northeastern University, Boston.
Treasurer: E. L. Quirin, Babson's Statistical Organization, Wellesley Hills, Mass.
Counsellor: William W. K. Freeman, Mutual Boiler Insurance Co., Boston.
Counsellor: Henry D. Locke, Liberty Mutual Insurance Co., Boston.

CHICAGO

The Statistical Techniques Group of the Chicago Chapter had its first luncheon meeting in October. Howard L. Jones of the Illinois Bell Telephone Company spoke on "Statistical Inference: Problems in Drawing Conclusions from Statistical Data". Dr. Clyde W. Hart, well known leader in public opinion research, spoke on "Public Opinion Polls in the Elections" at the October 28 meeting.

November 4, Dr. W. J. Youden, Statistical Engineering Section, National Bureau of Standards, spoke on "Analysis of Samples Consisting of Three Measurements, in Quality Control Experiments and Elsewhere"

On November 9 the topic "The Universal Use of Statistical Methods: Finding Statistical Tools in the Other Fellow's Garage" was presented by Dr. L. J. Savage, Institute of Radio-biology and Bio-physics, University of Chicago.

Frank G. Dickinson, Doctor of Philosophy in Economics, was the speaker at the November 18 meeting showing how the common failure of consumers to take the public debt into account in their personal bookkeeping has resulted in overpurchasing and inflation.

CONNECTICUT

Developments of Ranking Statistics for Psychological Data were discussed at the November meeting of the Connecticut Chapter. The speaker was John W. Whitfield, Sr., Scientific Officer for Medical Research Council, Psychological Laboratory, Cambridge University.

DENVER

The October meeting of the Denver Chapter was devoted to a discussion of "Statistics on Public Health". Dr. Florence Sabin, nationally known public health authority, was the speaker.

HAWAII

On November 10 the Hawaii Chapter held a joint dinner meeting with the Public Administrators' Association at which Dr. Max D. Kossoris, Regional Director of the San Francisco Regional Office of the Bureau of Labor Statistics, spoke on a program of labor statistics for Hawaii. He is now engaged in a survey of local needs in the field of labor statistics at the request of the Territorial Department of Labor and Industrial Relations.

NEW JERSEY

A panel discussion on "Some Current Statistical Problems of Testing and Selection" was held at the October meeting of the New Jersey Chapter. L. L. Thurstone, University of Chicago, widely known as a pioneer in psychological testing and measurement and for his development of factor analysis and psychophysical theory, started the panel by discussing "Some Statistical Questions about Twin Data".

John C. Flanagan, Pittsburgh University, discussed "Units and Scaling in Educational and Psychological Tests". Paul Horst, University of Washington and E. F. Lindquist, Iowa University, led general discussion of other statistical problems.

Opinion Polls vs. Election Results were discussed by Dr. Hadley Cantril, Professor of Psychology at Princeton University and Director of the Office of Public Opinion Research, at the November meeting. Other members of the speaker's panel were: Lawrence L. Benson, Archibald M. Crossley, Harwood Childs, Frederick F. Stephan, Paul Hatt and Harold Gosnell.

OKLAHOMA CITY

The Oklahoma City Chapter held its first fall meeting in October. There were three speakers: K. D. Blood spoke on the methods used by "Agricultural Estimates" in estimating acreage and production of crops; W. G. Hill discussed the operation of a state farm census; R. S. McCauley spoke on the forecasting of wheat yields in Oklahoma.

The November meeting had as its principal speaker, Dr. Adlowe Larson, Economist at Oklahoma A & M College. He spoke on "Problems to be considered in developing a National Agricultural Price Policy"—a price policy making provisions for clearing the market, making the best use of resources, and offering some income stability.

PHILADELPHIA

Louis H. Bean spoke at the October meeting of the Philadelphia Chapter on "Forecasting Elections". Mr. Bean, who has been associated with the U. S. Department of Agriculture for the past 25 years, is well known for his forecasting. Two of his more recent publications on the topic are "Ballot Benavior" and "How to Predict Elections".